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Index of regional economic development. Some considerations and the case of Poland

Abstract: A measure of economic development for regions is proposed in the form of a multi-component index. This measure is composed of the following aspects: technology, infrastructure, human capital and social capital and defined by an array of indicators. Such a measure has significant advantages over the most commonly used indicator of GDP per capita. The statistical data based on which it is built are freely available and with a much shorter time lag than GDP at the regional level. This indicator makes it possible to depict economic factors behind long-run economic growth as well as to include less measurable factors such as social change, environmental degradation, etc. On the one hand, the proposed indicator comprises symptoms of the quality of life, and on the other hand, it includes factors which are essential for long-run economic growth and productivity. The authors show usefulness of such an indicator for policy formulation, which is rarely pointed out in the case of other indexes and is especially important at a time when long-run economic growth, and also development, in high-developed countries is endangered. The authors also discuss some general aspects of constructing indexes of economic development for regions, e.g., the often omitted problem of inclusion of cyclical indicators in the indexes of development. Empirical analysis of the proposed indicator is made for the NUTS-2 regions of Poland for the years 2009–2011.

Keywords: economic development, regional development, development index, long-run growth, external effects.

Wskaźnik rozwoju gospodarczego województw

Streszczenie: W artykule zaproponowano miernik rozwoju społeczno-gospodarczego województw o postaci wskaźnika wielokomponentowego. Miernik obejmuje następujące obszary: technologia, infrastruktura, kapitał ludzki i kapitał społeczny, które definiowane są przez wiele innych wskaźników. Posiada on znaczące przewagi w stosunku do najczęściej stosowanego wskaźnika PKB *per capita*. Dane statystyczne, na podstawie których jest tworzony, są powszechnie dostępne i ze znacznie mniejszym opóźnieniem niż PKB na poziomie regionów. Wskaźnik ten pozwala ująć czynniki gospodarcze związane z długookresowym wzrostem gospodarczym, jak i efekty zewnętrzne, takie jak zmiany społeczne oraz zanieczyszczenie środowiska i inne. Zaproponowana konstrukcja wskaźnika obejmuje elementy wskaźników jakości życia, popularnych na poziomie krajów, jednak uwzględnia również czynniki niezbędne dla rozwoju gospodarek, a prowadzące do wzrostu wydajności pracy. Autorzy stoją na stanowisku, że takie ujęcie jest niezbędne w dobie problemów gospodarek z długookresowym wzrostem gospodarczym, wpływającym na ich rozwój. W artykule dokonano analizy empirycznej zaproponowanego miernika w odniesieniu do województw w latach 2009–2011. Stwierdzono podobieństwa, ale również wyraźne dywergencje wartości zaproponowanego wskaźnika w przekroju województw w stosunku do PKB *per capita*. Bazując na powyższych ustaleniach, dokonano także analizy przyczyn takiego stanu rzeczy.

Słowa kluczowe: rozwój gospodarczy, rozwój regionalny, miernik rozwoju, wzrost długookresowy, efekty zewnętrzne.

The processes of economic growth and development are conditioned by society. Furthermore, societies created structures that have defined certain social and political institutions as well as legal norms and standards of behaviour that influence its development. Economic development is impossible without social development, understood as a process of change in the attitudes of individuals and social groups (Kupiec 2008, p. 22). This unity and mutual conditioning of economic and social development are reflected in quantitative, structural and qualitative changes in economies at national, regional and local levels.

Economic development, measured by GDP per capita, does not consider many aspects that arise outside economic growth, including structural, social or ecological changes. At the country level, there are relatively many multi-componential indicators depicting development. However, at lower territorial levels – regional and local – there are few indicators by which long-run growth and development can be consistently measured.

Due to the complexity of economic development, it becomes essential to construct a specific synthetic measure or a group of measures, which will depict the level of economic development in a complete manner. A question arises on the factors that should be selected for the regional index, considering the different types of dissimilarities occurring between regions of a particular country than between countries.

The article is an attempt to develop an indicator of economic development at NUTS-2 regional level, as an alternative to the GDP per capita. General problems with constructing a regional index as well as certain policy applications of such a measure are discussed.

Literature review

Economic development is relatively complex and, thus, hard to define. Consequently, it is also difficult to measure and evaluate, because it includes a number of qualitative changes in the economy of a country, i.e. effects of structural transformation, technological change, changes in the education system, transformation in well-being conditions, changes in culture and other determinants of the quality of life. Economic development, bringing positive changes in the functioning of the national economy, material conditions, socio-cultural and human nature, also determines progress in social welfare. Problems with measuring this phenomenon with the use of one indicator led to the idea of constructing a multi-component index that would allow for an adequate analysis and assessment of economic development along with qualitative changes and external effects. Michalos (2007) indicates that any acceptable multi-component indicator must meet acceptability criteria. All indicators should be: easy to understand, reliable and valid, easy to obtain, periodically updated and comparable across jurisdictions, groups, etc.

It is widely recognized that a synthetic measure of development is GDP per capita. However, it does not encompass all aspects of economic development. This is connected to the fact that an increase in the level of technical equipment of work and labour productivity and qualitative changes that accompany them causes an increase in GDP per capita. Critics (e.g. Kuznets, Galbraith, Samuelson, Mishan, Nordhaus and Tobin, Hueting, Hirsch, Scitovsky, Daly, Hartwick, Tinbergen and Hueting, Arrow, Velling and Withagen, Weitzman and Löfgren, Dasgupta and Maler and Dasgupta) argue that GDP per capita has many limitations. It was devised purely as an economic measure and does not include the key issues of welfare, environmental protection etc. Thus, it cannot be used as a comprehensive measure of economic development of a country (see Lawn 2007, pp. 22–43 and Van den Bergh 2007, pp. 2–10). Due to the complexity of economic development, in the past decades many different indicators were established and used to study this phenomenon. A variety of such indicators were presented by Booysen (2002, pp. 132–138).

There exists a range of problems with the composition of multi-component indexes. The data used in calculating certain indicators are typically insufficient or incomplete, and the results of such calculations are directly contingent on the methods used to scale, weight and aggregate the components. In addition, the results are normally determined by the size and selection method of the sample (Ram 1982, pp. 227-247). Diewert states that the best method to resolve these problems is a continued search in the methodology for the creation of an indicator which, on the one hand, would universally depict economic development, and, on the other hand, would be characterized by its simplicity (Slottje 1991, pp. 684-693). Below are critical comments on hitherto built indicators.

Several authors point to the fact that specific indicators exclude one or more elements of the development, which has repercussions in their reliability. Perthel (1981, pp. 6–7) criticizes the use of the GID index for the lack of population structure or social inequalities components, as well as for the exclusion of law enforcement. This indicator also forces the use of far too few variables in its calculation. Another indicator which is often criticized for its limited measurability is the PQLI index. Todaro (1989, pp. 109–112) writes that two of the three components of this indicator are based on healthcare aspects, and that they are strongly correlated. One of the most common complaints regarding the HDI index is the fact that it excludes various types of social accomplishments, which have key significance for the quality of life (Lind 1992, pp. 96–97). Srinivasan (1994, pp. 240–242) states that this indicator does not reflect political freedom and human rights, while, for example Hopkins (1991, pp. 1469–1473) justifies it by the fact that these needs can also be fulfilled by authoritarian governments. Simultaneously, Streeten (1994, p. 236) introduces arguments explaining why political freedom and human rights cannot be a part of the HDI index:

1) the proposed variables are characterized by high variability in relation to the other three components, which may have a negative impact on the stability of the indicator over time;
2) the proposed variables are measured in a manner which is less objective than the other variables, which would consequently lower the objectivity of the index;

3) the relation between political freedom and economic development is not sufficiently defined.

A common critical argument is also the fact that certain indicators are calculated assuming the same variables for distinctly different countries. Anand and Ravallion (1993) propose that the HDI index be calculated separately for developed and developing countries (see also Streeten 1995, p. 26). They claim that the problems in countries with low and high incomes are diametrically different. They argue that it is also true for the environmental indicators as due to the difference in the level of economic and geophysical characteristics, countries must solve their problems within the natural environment individually. We believe that this complaint is insufficiently motivated, as there will always be weaker and stronger sides of a given economy. An index of development as a synthetic measure should indicate all of them and be widely comparable. In addition, from such a point of view, in the case of multi-component indexes it is possible to analyze specific areas of development. Lind (1992, p. 96), Ogwang and Abdou (2003) and Srinivasan (1994b, pp. 240–242) show the flaws of the HDI index, i.e. incorrect measurement of some data used to calculate it. Some of the fundamental variables are estimated based on a mathematical extrapolation, not with the use of actual observations. The remaining variables are estimated assuming various definitions of similar concepts (Srinivasan 1994b, pp. 240–242).

There is a strong criticism that components of indexes of development lack exactness and comparability. The selection of components of an index is strongly dependent on technical criteria such as availability and exactness of the data. Ideological considerations may also impact the selection of components. For example, Stewart (1985), McGillivray (1991) and Srinivasan (1994a), show the existence of a strong correlation between certain components of the HDI index. Social indicators are found to be strongly correlated with indicators of economic growth (Diener and Suh 1997, pp. 192–200).

Methods of weighting and aggregating variables used in calculating indicators have also been criticized. Todaro (1989, pp. 109–112) emphasizes that the method of weighted averages, which is used in the construction of some indexes is insufficiently justified as in various periods (years) diverse factors have significance. Thus, changing weight patterns should have been considered. However, it makes the analysis difficult and adds subjectivity. For this reason, we support the position that multi-component indexes should not be weighted.

One of the most important criticisms of the existing indexes is that they do not reveal much, having a low value for economic policy because of a lack of appropriate recommendations for policymakers. This argument often concerns those indicators that are based on income. The HDI index for example, was developed as a politically motivated measure and was, among other assumptions, to strengthen the development of countries through the undertaking of common attempts to improve the level and quality of health and education (Todaro 1994, pp. 63–66 and Elkan 1995, p. 12). Ogwang and Abdou (2003) state that HDI fails in this task, because it takes into account some averaged values of components, on the basis of which no conclusions can properly be drawn. One exception

may only be countries where the analyzed differences are significant. However, the index has not yet led to a significant improvement in the level of economic development throughout the world.

In the literature, there are few analyses of economic development of an NUTS-1 to an NUTS-5 region. Moreover, the application of GDP per capita at a regional level presents even more problems than in the case of countries. Michalek and Zarnekow (2011 p. 2) discuss the most important ones:

1) regional GDP per capita as a measure of welfare ignores many important aspects of regional quality of life, such as education, health, intra-regional income variations, quality of the natural environment, etc.;
2) regional GDP per capita does not consider price fluctuations and purchasing power in specific regions in a given country;
3) measurement of the regional product is biased because of it is hard to identify flows of capital between regions.

The inconveniences with the use of GDP per capita and the need to consider economic, social and environmental aspects of development in particular regions of a country, provide the motivation to create an alternative and more objective indicator of economic development in regions.

Ewusi (1976, pp. 80–83), based on ten selected variables, analyzed disproportions at the regional level in Ghana. His study showed glaring differences between specific regions of this country. The region ranked as the most developed was indexed twice as high as the region with the second rank. Ariaf (1981, pp. 259–260), based on a multicomponent index with 16 variables categorized in four groups (A. Economy, B. Housing, C. Education, D. Health), analyzed the disproportions of economic development among the regions of Malaysia. He points out the existence of regions similar in regard to their economic profile, but significantly different in their level of development. This is undoubtedly a signal for the entities in charge of regional policy. Ohlan (2012) based on 43 variables categorized in three groups (Agriculture, Infrastructural Facilities, Industry), analyzed the disproportions in the level of development between three regions of India. The constructed index showed that the southern regions are more developed than the central or northern ones, and that development in the southern regions was also more balanced. International comparisons show that the level of economic development of regions and symmetry of regional development in India is significantly lower than in Ghana, but simultaneously, higher than in Malaysia.

Index composition

In the construction of an index of economic development for regions we start with a model of long-run economic growth in a general form (Romer 2011)[1].

$$Y_t = f\left(A_t, K_t, L_t, H_t\right), \tag{1}$$

[1] The stages of creating our regional index of development are corresponding with the guidelines for constructing composite indicators developed by the OECD (2008).

where Y_t represents long-run economic growth, A_t is a technical change, K_t is a physical capital, L_t is a quantitative measure of the amount of work (labour force) and H_t is a human capital.

The general growth model (1) is a production function. Since economic development is a concept considered in a long-run[2], we are not interested in the explanation of economic fluctuations (business cycle, see e.g. Baxter and King 1999). Therefore, the explanatory variables and economic growth described by the model (1) should only be regarded as long-run changes (trend), or potential output, explained by the corresponding potential employment and long-run path of accumulated capital, i.e., without cyclical fluctuations of investment etc.

We believe that a common mistake in composing an index of development is the inclusion of synthetic measures of specific areas of development, which undergo cyclical fluctuations (see Conference Board 2001, for constructing multi-component business cycle indexes)**.** An example would be the unemployment rate, which is clearly counter-cyclical. As a result, an index composed based on such a measure will, in addition to development, also include the effects of the business cycle. Thus, during cyclical expansions and contractions, this measure will distort the analysis of real development. Certainly, there can also be situations in which sharp fluctuations (e.g. crises) affect the long-run trend of macroeconomic aggregates, and consequently, economic development. However, such changes will be reflected in changes in the long-run trend of the variables. An example of a situation in which short-run fluctuations affect the long-run economic equilibrium is hysteresis in unemployment. The analysis of development should be made assuming weakly cyclical variables, while in the case of strongly cyclical variables, the fluctuations should be filtered out, before the analysis.

Long-run economic growth is accompanied by other changes in the economy. Structural, social and environmental changes can be named among them. Altogether, they account for economic development (Ray 1998). Development is closely associated with long-run growth, which is also a component of the development (Taylor and Lybbert 2012). Various aspects of both influence each other. However, development is a broader term, as it includes, apart from the purely economic factors described by the function(1) also changes, which can be defined as "qualitative" Some of them only conceptually differ from those presented in the model (1), e.g., increased innovativeness leads to technological progress, which can be measured quantitatively, but also mean a qualitative improvement. Thus, the function (1) showing growth, is the starting point for the definition of the components of economic development. Presenting its elements in a relative (intensive) form, e.g., per capita, per employee, per entity, we get measures comparable across regions. They require supplementation by the effects that are not directly related to the mechanism of product (income) formation.

[2] Long-run change is a concept related to the situation in which the system or the economy is in a steady state or, in other words, in a long-run equilibrium (see e.g. Romer 2011). An empirical manifestation of a long-run equilibrium in economics is a long-run trend of a particular time series which is devoid of economic fluctuations. It can be estimated in a finished sample by econometric methods (see e.g. Mills 2003).

The main difference between the index we are proposing and those discussed in the first part of the article is that our index refers to the NUTS-2 regional level, while most of the above concern the national level. This narrows our analysis to a much smaller range of available statistical data. It also leads to the fact that measures of specific areas of development we propose may not always represent the cause, or the direct effects of certain phenomena and processes leading to development. In areas for which there is no adequate statistical data on the regional level there is a need to introduce variables which are symptoms of developmental processes. However, development across regions of a country is not as diverse as it is between countries. Therefore, it is not necessary to take into account certain components.

Based on the factors defining development described e.g. by Ray (1998) we propose the following grouping of components of the index of economic development for regions:

- technology,
- infrastructure, including:
  - physical capital,
  - the environment,
- human capital, including:
  - education,
  - demography,
  - labour market,
- social capital, including:
  - health,
  - social inequality,
  - community.

The four components are assigned equal weights, because we do not exactly know which one of them could have priority. It results from the fact that there is no unified measure of development. However, we know that they all are crucial for development. They all should be evolving in the same direction to achieve sustainable development. Components of the index are described by sets of indicators. Relatively few of them concern outlays. Public as well as private sector outlays influence the economy mainly through demand-side, i.e., short-run factors. They do not indicate whether the intended result has been achieved or to what extent supply-side, i.e, long-run factors have been affected (see e.g. Burda and Wyplosz 2012). Therefore, we decided that it would be better to include measures that illustrate specific areas of development as directly observable consequences of certain actions and changes or those of their symptoms, when the effects are not measured (Figure 1).

The causes of development are certain unobservable factors, which are not directly measurable. They are connected to historical conditions, permanent shocks, such as technology shocks and others, among which there can also be outlays. However, we do not know which expenditures affect development, and which are only demand-side and transitory. Causal factors can be measured by indicators that register their direct effects, i.e. percentage of innovative

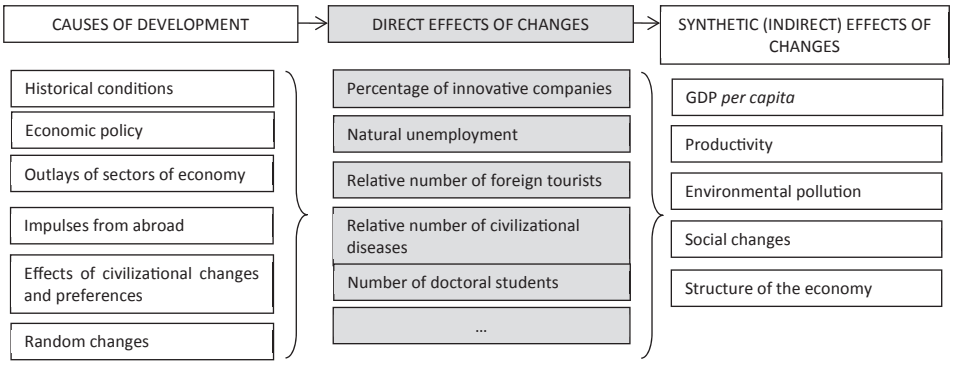


Figure 1. Causal relations and economic development measure

Source: own work.

firms, changes in natural (long-run unemployment) etc. These factors are the most interesting in our study, because they represent the results of a specific developmental impulse, and are not too synthetic. However, they are also observed in synthetic measures such as income, productivity, polluted air and others. Some of the synthetic or indirect effects of initial factors are income-based, something we want to avoid; others are not directly and continuously measurable. They are also very general and lack the specific information we want to get for the purposes of policy-making. The income-based indicators also refer to GDP, which can be decomposed according to equation (1). Inclusion of them would mean the inclusion of the same information multiple times.

The data we consider come mainly from the Central Statistical Office (CSO) of Poland as well as from Eurostat database. Another important source of data is the Social Diagnosis reports for Poland (Czapinski and Panek 2009, 2011). They supply indexes of subjective well-being. Although their drawback is that they occur only once every two years, they are important measures of social changes. Assuming a range of statistic indicators, we created an initial set of potential components. At the beginning of the analysis, we wanted to eliminate those potential index components that are clearly correlated. We tried to balance synthetic and specific measures, not to duplicate GDP, but also not to go into very detailed indicators. Another problem we faced was that there are positive indicators which often decrease in developed countries. Clear examples are the birth rate and environmental pollution. We believe that they should remain as components of the index, because they reduce the quality of life and prospects for development. In the index structure, we wanted to recognize both synthetic quantitative measures such as life expectancy, as well as qualitative and structural issues, such as morbidity and social inequality in order to avoid obtaining very similar results for different regions. Another principle adopted by us was the choice of measures characterized by the shortest possible delay of data publication. The CSO publishes data for the NUTS-2 regions generally with a 9-11-month delay, similarly as Eurostat and the Social Diagnosis. Regional accounts for Poland (given by the CSO) and data of the European Patent Office (EPO) are published

with a delay of around two years, so we wanted to avoid them. Another reason supporting the need for the construction of a new index of development is a very long delay of publishing the regional accounts in Poland. This index should not be based on the national or regional accounts' measures. If particular data were not available for the previous year, the latest attainable data were used. Following comes the description of preliminary index components. Final components were shown in Table 5 (Appendix).

Innovation is one of the key factors driving productivity, which is in turn one of the most important indicators of economic efficiency, as well as a significant factor in determining competitiveness. Technology shock for centuries has also been driving the development of humanity. Therefore, innovation should be an essential component of an overall measure of development, not just economic progress. Neoclassical growth theories treat the discovery of new goods and technologies (in addition to specialization of work), as factors driving technological progress (see Romer 2011). The measure of innovativeness includes primarily patents, directly indicating the emergence of a new innovation. That is why we preferred to take into account the number of patents per capita, rather than research and development (R&D) expenditures per capita The latter reflects only expenditure, while the former the effects of innovation performance. We assumed that innovations affect development, despite referencing only to expenditure on R&D, as it was done in Romer's (1990) growth model. Another measure is the percentage of enterprises that use information and communication technologies. It represents changes in the information society (at NUTS-2 level Eurostat or the CSO do not provide data for households). These indicators are supplemented by the share of revenues from the sale of market innovative[3] products in the overall revenues from sales. It measures the relative revenues coming from innovative products. The means of automation of production processes (such as computer-controlled production lines) per entity, indicates the technological advancement of companies and is another preliminary component. Besides these, employment in R&D to total employment, and thus a relative measure of human resources in this type of activity was taken into account. It was also adopted in the Regional Innovation Scoreboard (RIS), as one of the measures of innovation performance (Hollanders et al. 2009).

Infrastructure includes the size of the physical capital as a factor of growth, but also its quality and sophistication. It's preliminary measure is gross fixed assets per entity, the density of the transport network measured by the length of roads and highways, traffic of passengers and cargo handling at airports, but also housing space per resident and usage of installations, i.e. sewerage as a percentage of the total population. The second part of this section relates to sustainable development in terms of quality and activities related to environmental protection, as well as tourist infrastructure and its usage. In this case, we applied such direct measures of natural environment as the number of national parks and nature reserves. They were supplemented by the number of foreign tourists

[3] Market innovative means innovative in the scale of a market. An alternative measure available in official statistics is firm innovative. Such innovation has a narrower scale.

using accommodation per the size of a region. The share of recycled waste in the amount of waste generated, air pollution retained in pollution reduction devices as a percentage of pollutants produced as well as environmental protection and water management facilities in the region per 100 km^2 were used as measures of environmental pollution prevention.

Human capital refers both to the classical growth theory, which defines "labour" as a production factor otherwise called labour force, and the works of Uzawa (1965) and Lucas (1988), which consider the „quality" of the workforce, its qualifications – skills and knowledge. According to Romer's growth model (1990), human capital also, through specialization, affects innovation. The OECD (2001) gives the following definition of human capital: "the knowledge, skills, competencies and attributes embodied in individuals who facilitate the creation of personal, social and economic well-being". The demographic part of this area of economic development is: the birth rate, fertility rate, net migration, dependency ratio, and the relative number of marriages as a tendency to cultivate the family. Another part of human capital deals with education. This includes enrolment rates, the percentage of pupils at the age of 17, the number of students per 10,000 inhabitants, the share of the population aged 25-64 with higher education and those involved in lifelong learning, doctoral students and postgraduate students per 10,000 inhabitants, as well as the percentage of students of technical studies. The labour market is the last group of components of human capital. It takes into account the activity rate, natural unemployment rate, the percentage of economically inactive persons due to exhaustion of all known job search methods (conviction of the impossibility of finding a job), and the percentage of long-term unemployed. In the calculations, we used mainly Labour Force Survey data, less vulnerable than data from Polish labour offices as regards the impact of labour market policies[4].

The final group of components of the index of development is social capital. To describe this, we take into account health, social inequalities and community. The OECD (2001) states that "social capital is networks together with shared norms, values and understandings that facilitate co-operation within or among groups". Networks relate to the objective behaviour of actors who enter into associative activity. Shared norms, values and understandings relate to the subjective dispositions and attitudes of individuals and groups, as well as sanctions and rules governing behaviour, which are widely shared. In our approach, we understand "health" as a social factor, not directly related to economic traits – knowledge and skills, which are included in the technology and human capital, respectively. This distinction is crucial because health is not traditionally included in human capital measures used in economic growth models. We want to distinguish social aspects of growth. The first area includes relative morbidity as a result of selected diseases, including civilizational diseases, infant deaths per 1,000 live

[4] Labour offices in Poland keep evidence of registered unemployment. According to this definition, to be unemployed one has to be registered as such and appear in the labour office for paid social work if called. These records show higher unemployment rate than LFS and the status of registered unemployed is subject to abuses (a person is registered as unemployed while works in the "grey zone", i.e. unregistered employment).

births, life expectancy, as well as the number of medical staff and hospital beds in relation to the number of hospitalized persons. This group also includes physical and psychological well-being as well as life stress. The second area contains disposable income per capita, the population at risk of poverty, civilizational level, pathologies, material and social well-being as well as the rate of inequality between men and women in the level of education, in life expectancy and in the labour market. Community is measured by social capital measure (Czapinski and Panek 2011), crimes identified in the finished proceedings per 10,000 inhabitants, the number of cultural institutions (cinemas, museums, theatres, operas, etc.) in relation to the population, the absolute number of organized events throughout the year, and non-profit organizations per capita.

In recent years, a growing attention in public statistics has been paid to measures of the quality of life. An example is the Legatum Prosperity Index (LPI), developed by the Legatum Institute[5]. It is an annual ranking based on a variety of factors including wealth, economic growth, personal well-being, and quality of life. Another example is the Better Life Index (BLI), constructed by the OECD[6]. It is an indirect result of the work of the Stiglitz Commission, which created the Report on the Measurement of Economic Performance and Social Progress. Debates on such measures are also on-going at Eurostat[7] (Table 1[8]).

Table 1. OECD Better Life Index and Legatum Prosperity Index

Description	Number of components	Selection method	Scaling method	Weighting method	Aggregate form	Country coverage
Better Life Index	24	ad hoc	none	equal average	additive	34
Legatum Prosperity Index	89	ad hoc	none	correlation coefficient	additive	142

Description	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Better Life Index		x	x			x	x	x	x				x	x	x	x	x		
Legatum Prosperity Index		x	x			x		x	x							x		x	x

A – demographic dynamics, B – education, training, knowledge, C – health, food and nutrition, D – human settlement, infrastructure and communication, E – political and social stability, F – culture, social structures and family values, G – environmental resources, H – civil and political institutions, I – income and economic growth, J – unemployment and methods of diminishing unemployment, K – poverty and inequality, L – economic freedom, M – housing, N – work, O – life satisfaction, P – security, Q – the balance between work and family, R – personal freedom, S – entrepreneurship & opportunity

Source: own calculations on the basis of CSO and Eurostat data.

[5] www.legatum.com/institute

[6] www.oecdbetterlifeindex.org

[7] http://epp.eurostat.ec.europa.eu/portal/page/portal/gdp_and_beyond/documents/wr_speach.pdf, 23.01.2013.

[8] We use the same form of presentation as Booysen (2002, pp. 132–138).

Quality of life and economic development are related concepts, as the former should go with the latter. However, these measures should not be equated. In some cases, they may even interfere with each other. At present, Western Europe and other developed countries reach the limits of fast long-run growth. They approach the period wherein traditional growth and development factors, e.g. physical capital, are insufficient to reach higher growth and maintain a high standard of life. Forecasts for the coming years show low rate of long-run growth, should rapid technological advances and higher economic activity not be achieved. This threatens economic development. Such changes will require higher productivity. An increase in productivity most often goes hand in hand with a sacrifice of free time to work, which in turn may result in a reduction of social satisfaction, and thus the quality of life. Therefore, our index emphasizes the creation of long-run growth and development more than the indexes of quality of life. It is the reason why the index we are proposing lacks the measures of free time. It is, according to us, an improper determinant of economic development, because it promotes low productivity. As a result, we substituted this measure by measures of subjective well-being.

Until now, a few papers on sustainable and social development for Poland have been written. In 2011, the Central Statistical Office presented Sustainability Development Indicator for Poland, which contained indexes assigned to the following orders (then divided into different groups of indexes)[9]:

- social order,
- economic order,
- environmental order,
- institutional and political order.

This study constructs an index of sustainable development at the national level. In the literature, there are analyses of regional development in Poland. They are based on the methodology used by the CSO. They show remarkable differences between the regions. Only Pomorskie, Dolnośląskie and Mazowieckie represent a harmonious and quite a high level of development in terms of the social, economic and environmental level, whereas Opolskie and Swietokrzyskie represent the lowest levels thereof (Roszkowska 2014).

The National Human Development Report (2012) issued by the United Nations Development Programme, presents a study of social development at the local level in Poland with the use of the Local Human Development Index (LHDI). The index was constructed on the basis of the existing methodology of the HDI index. The LHDI index shows how, and most importantly, why the various administrative units of the country position themselves relative to each other, what their strengths and weaknesses are, and which path of social development they have chosen. The study was based on the data from 2007 and 2010 with the use of public statistics. The LHDI index was based on the health index (HI), education index (EI) and the wealth index (WI).

[9] The list of included indicators is shown in the report *Wskaźnik zrównoważonego rozwoju Polski* (Sustainable development indicator for Poland), pp. 18, 72, 112, 161.

Analysis of components

We assume that the pre-selected indicators carry important information on the development of regions. However, some of them reproduce part of the information of others, as a result of which some aspects of development occur more than once. Thus, their weights are higher in comparison with others. In order to eliminate the common part of variance, factor analysis may be used. In the present case, this analysis has two drawbacks. The first one is that it reduces the possibility of interpreting the various measures of development. The second one is the fact that the information which the indicators include will change over time, which would require yearly update of the component selection. This would consequently lead to a change in the composition of the index and significantly complicate its comparison in time. Therefore, in the literature (see Booysen 2002) correlation analysis is most often used to eliminate non-essential ones among the correlated preliminary indicators. For this purpose, we analyzed the Pearson linear correlation coefficient between all of the preliminary indicators for the year 2009[10]. First, the correlation analysis between indicators within particular areas of development was conducted, then between indicators from different areas. This allowed for the elimination of a number of preliminary indicators (Table 6 in the Appendix). We assumed the following ranges of correlation coefficient: if $r \in < 0.7,0.9$ a strong correlation exists between indicators, $r \in < 0.9,1$ means very strong (almost complete) correlation. In some economically interpretable cases, if $r \in < 0.6,0.7$ we assumed that the correlation coefficient is also strong enough to reject one of the correlated indicator. In the case of smaller values of the correlation coefficient we assumed that the indicators carry sufficiently specific portion of information to keep them.

In the area of technology there is an obvious strong positive correlation between the number of submitted and granted patents to the Patent Office of Poland per capita (r=0.85). These variables were also correlated with the relative employment in R&D, although higher correlation coefficients were observed in the case of patents submitted than granted (0.84 and 0.64, respectively). Both variables were also significantly correlated with productivity and potential output growth rate (r=0.7). Labour productivity was very highly correlated with disposable income (r=0.94). The number of patents clearly shows similar trends as two of the main indicators of economic growth, particularly in the long-run. Among the above variables, we chose the relative number of patents granted to the Patent Office of Poland (data published with a shorter lag than in the case of the European Patent Office) as one of the components of our index. It expresses the results of the innovation process. Employment in R&D shows innovative activity, but to a lesser extent its effectiveness. We decided to include relative human resources in high-technology companies as an indicator illustrating job creation in innovative sectors (as a result of innovation process) and also including companies that despite not having extensive infrastructure, are innovative (the so

[10] The tables are too large to include in this article. They are available upon request.

called "born globals"). Labour productivity and potential output are measures based on the same factors as GDP, which we wanted to avoid.

In the case of infrastructure, strong positive correlation between the movement of passengers at airports and movement of cargo can be noticed. Both variables were also highly correlated with gross value of fixed assets. Strong positive relation characterized the relative number of tourists and the number of five-star hotels (r=0.89). The number of foreign tourists using accommodation was found to be correlated with the movement of goods at airports (r=0.65) and the number of five-star hotels (r=0.79). The use of water supply and sewage systems were clearly correlated (r=0.7). From among the variables concerning tourists, we decided to retain the relative number of foreign tourists, which shows the importance of the region as a tourist destination. We also kept passenger movement at airports, but eliminated the movement of cargo and the value of fixed assets, the latter being too general a variable, and also promoting large, costly, and possibly traditional industry infrastructure. Another argument is that the earlier retained means of automation of production processes was correlated with this variable, but illustrates innovative physical capital.

Human capital indicators' correlation analysis showed a strong positive relation between the relative number of students in higher education and post-graduate students. The first indicator was chosen as more common in such analyses. The share of the population undergoing lifelong learning was also highly correlated with postgraduate students (r=0.78). Relative number of PhD students turned out to be highly correlated with the corresponding number of employees in R&D (r=0.92) and patent applications to the Patent Office of Poland (r=0.85). A strong negative relation characterized the dependency ratio (the number of people of retirement age and the number of people in the pre-working age ratio) and the birth rate (r=-0.9), and was lower but still fairly high between the dependency ratio and marriages per 1,000 inhabitants (-0.66). The latter indicator was, however, also significantly correlated with the fertility rate (r=0.75), which led to its exclusion from further analysis. The enrolment rate for primary schools was highly correlated with the fertility rate and net migration, which may indicate that these factors affect schooling at this level. Therefore, this variable was also eliminated from the analysis.

In the social capital component, the number of medical workers was correlated with the morbidity rate as well as a few other indicators. The first variable was excluded from the analysis. The subjective measure of civilizational level was correlated with disposable income per capita (r=0.72) and material well-being (r=0.87). The latter measure was correlated with similar indicators, but the moduli of coefficients were higher, thus it was excluded from further analysis.

The chosen indicators were standardized with use of the z-scores method. This method has disadvantages. One of the most important ones is the assumption of normal distribution, which may not be true in the case of such a small sample. However, this method is widely used in such analyses. Another one is the fact that every change in administrative division of regions decreases the comparability of the indicator. However, it is extremely difficult to invent a measure that is prone

to administrative changes. The same thing would occur if any of the statistical measures used were changed. Means for four groups of components were computed. For the reasons explained earlier, all of the components had the same weights. To compute the index of development for the year 2009, an unweighted mean for groups of components was computed and then rescaled. The index for 2009 was constructed as follows:

$$RED_{2009,R} = 100 + \left(\frac{\sum_{g=1}^{4} GC_{2009,R}}{4} 100 \right), \tag{2}$$

where is the index of regional economic development for 2009 for region , is the group of components, and is an th component of the group. Indexes for the following years were calculated by correcting values for groups of components by mean yearly growth rates of its components as follows

$$GC_{2009+k,R} = \frac{\sum_{c=1}^{n} C_{2009+k-1,R}}{n} + \frac{\sum_{c=1}^{n} \left(\frac{C_{2009+k,R}}{C_{2009+k-1,R}} - 1 \right)}{10n}, \tag{3}$$

for 2009 + *k* th year. Such an indicator is unweighted and all the groups of components have the same meaning.

Cronbach's Alpha (Cronbach 1951) calculated for the four components of the index in the base year, i.e. 2009, equalled 0.752. which shows acceptable internal consistency of the overall index (see OECD 2008 and Nunnaly 1978). It means that the group of components is quite coherent and the components describe the same composite phenomenon – economic development. All components are positively correlated with the overall index with correlation coefficients between 0.51 and 0.66 (Table 7 in the Appendix). Higher values were not expected, because some of the areas of development are known to be contradictory to others. The most notable examples were found to be:

- environmental pollution,
- demographic burden,
- civilizational diseases,
- life stress,
- crimes notified.

The above external effects diminished the overall index values in high-income regions, while increasing the values in the lower-income regions.

Discussion

The index values for regions of Poland 2009- 2011 along with GDP per capita are presented in Table 2.

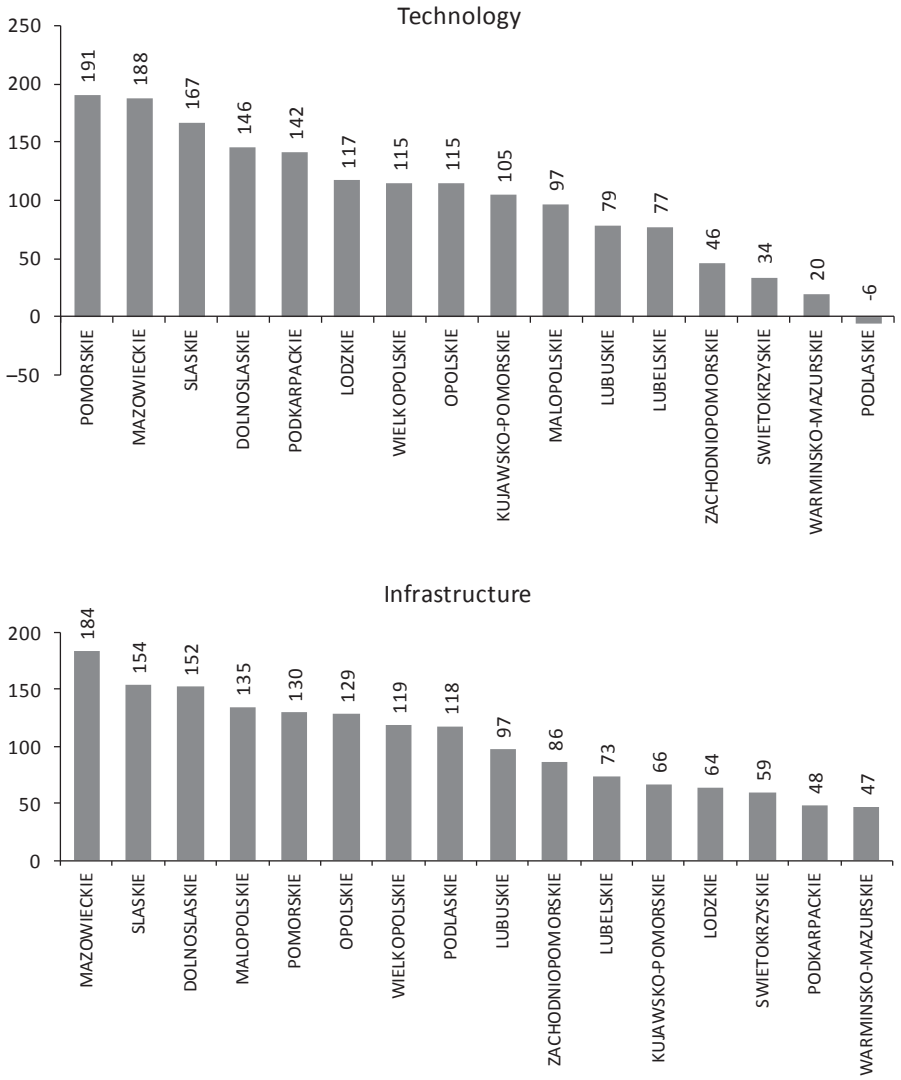
Table 2. Index of development for regions of Poland and GDP per capita in 2009–2011

No	Region	Index of development			Change in index of development	GDP *per capita*			Change in GDP *per capita*
		2009	2010	2011	2011–2009	2009	2010	2011[a] (forecast)	2011–2009
1	Lodzkie	82.6	82.5	82.3	–0.3	32,204.00	34,180.00	36,458.02	4,254.02
2	Mazowieckie	166.8	167.4	167.1	+0.3	**56,378.00**	**60,359.00**	**63,185.40**	**6,807.40**
3	Malopolskie	130.4	130.9	130.6	+0.2	30,251.00	31,501.00	33,895.40	3,644.40
4	Slaskie	119.5	119.7	119.6	+0.1	37,800.00	39,677.00	43,197.27	5,397.27
5	Lubelskie	83.7	83.9	84.0	+0.3	**23,679.00**	25,079.00	**26,780.77**	3,101.77
6	Podkarpackie	104.1	102.1	102.4	–1.7	24,157.00	**24,973.00**	26,904.38	2,747.38
7	Podlaskie	68.8	69.1	69.1	+0.3	25,983.00	26,985.00	28,579.11	**2,596.11**
8	Swietokrzyskie	49.9	48.9	44.5	–5.4	27,357.00	28,134.00	31,058.21	3,701.21
9	Lubuskie	59.7	59.9	71.5	+11.8	30,108.00	31,348.00	33,676.13	3,568.13
10	Wielkopolskie	131.1	131.4	131.2	+0.1	37,462.00	38,629.00	41,619.15	4,157.15
11	Zachodniopomorskie	81.3	80.9	81.6	+0.3	30,978.00	32,268.00	33,655.13	2,677.13
12	Dolnoslaskie	129.4	129.5	128.2	–1.2	38,427.00	41,750.00	43,367.28	4,940.28
13	Opolskie	106.0	105.5	106.1	+0.1	28,811.00	29,498.00	33,596.33	4,785.33
14	Kujawsko-pomorskie	74.3	74.1	75.8	+1.5	29,866.00	31,107.00	33,074.72	3,208.72
15	Pomorskie	143.8	146.2	144.7	+0.9	34,296.00	35,597.00	37,599.74	3,303.74
16	Warminsko-mazurskie	68.4	69.2	68.2	–0.2	26,029.00	27,228.00	28,669.36	2,640.36

[a] GDP per capita for the year 2011 has been forecasted on the basis of the data for Poland and predicted changes in the regional GDP structure.

Source: own work.

The Mazowieckie region had the highest value of the development index in each of the three years; the lowest values were recorded in Swietokrzyskie. The difference between these two regions in 2009 amounted to 116.9 points, and within the next two years reached 122.6 points. Swietokrzyskie reported an equally high difference in relation to the country's average. In 2009, it amounted to 50.1 points, then 51.2 points a year later, and in 2011 it reached the level of 55.9 points. The development index value calculated for the Swietokrzyskie region in 2011 was more than twice lower than the national average and nearly four times lower than the highest value in this statement – for the Mazowieckie region (Figure 2). This developmental gap slowly continues to grow.



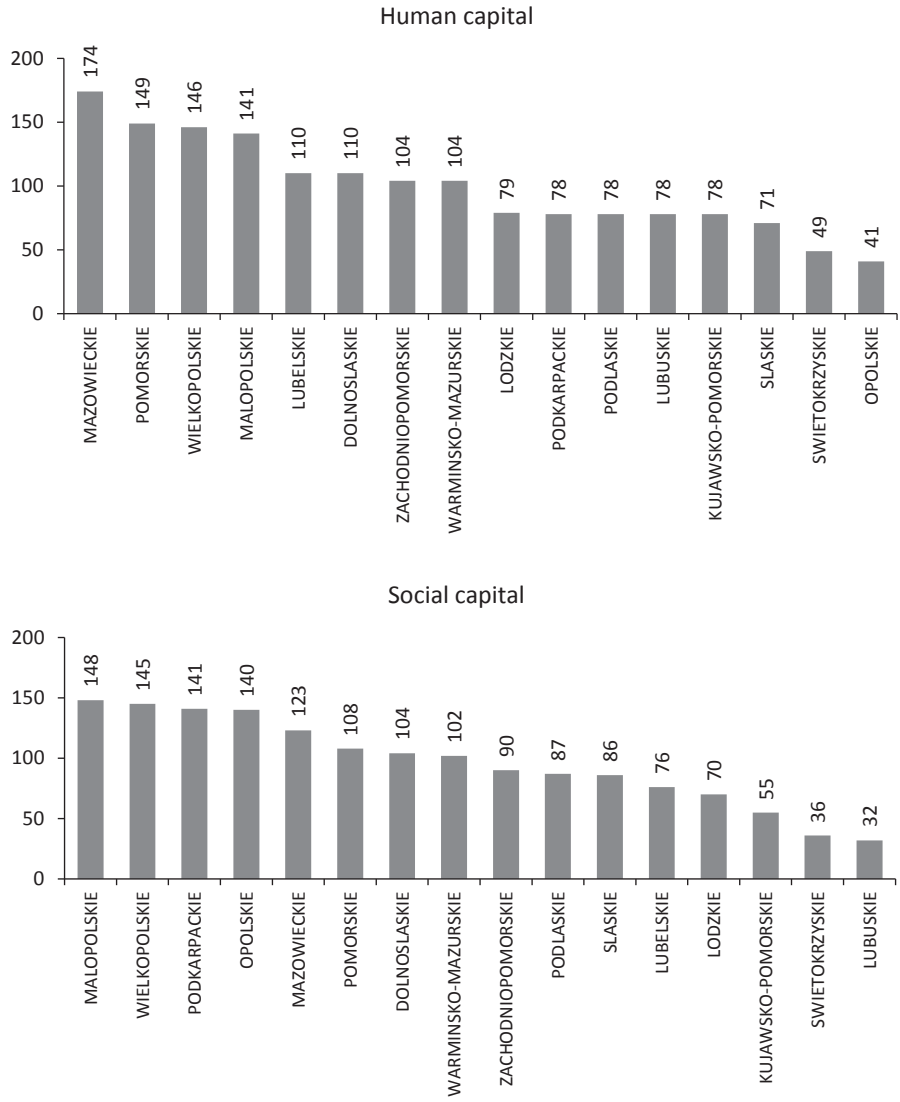


Figure 2. Average values of the groups of components of development index in regional breakdown in 2011

Source: own calculations on the basis of CSO and Eurostat data.

A similar stability of the position in the development ranking is found with more regions (Table 3). Analysis shows that despite the changes of index values shown in Table 3, the structure and order in the ranking of the twelve most developed regions did not change throughout the period considered. Shifts in the standings occurred just in relation to three regions, i.e. Podlaskie, Warminsko-Mazurskie and Lubuskie. Only Lubuskie rose in the ranking, from the 15th to the 13th position. In the case of the other two regions, the change was to one position lower in the ranking.

Table 3. Position of regions of Poland according to the index of economic development

2009			2010			2011		
1	Mazowieckie	166.8	**1**	Mazowieckie	167.4	**1**	Mazowieckie	167.1
2	Pomorskie	143.8	**2**	Pomorskie	146.2	**2**	Pomorskie	144.7
3	Wielkopolskie	131.1	**3**	Wielkopolskie	131.4	**3**	Wielkopolskie	131.2
4	Malopolskie	130.4	**4**	Malopolskie	130.9	**4**	Malopolskie	130.6
5	Dolnoslaskie	129.4	**5**	Dolnoslaskie	129.5	**5**	Dolnoslaskie	128.2
6	Slaskie	119.5	**6**	Slaskie	119.7	**6**	Slaskie	119.6
7	Opolskie	106.0	**7**	Opolskie	105.5	**7**	Opolskie	106.1
8	Podkarpackie	104.1	**8**	Podkarpackie	102.1	**8**	Podkarpackie	102.4
9	Lubelskie	83.7	**9**	Lubelskie	83.9	**9**	Lubelskie	84.0
10	Lodzkie	82.6	**10**	Lodzkie	82.5	**10**	Lodzkie	82.3
11	Zachodniopomorskie	81.3	**11**	Zachodniopomorskie	80.9	**11**	Zachodniopomorskie	81.6
12	Kujawsko-pomorskie	74.3	**12**	Kujawsko-pomorskie	74.1	**12**	Kujawsko-pomorskie	75.8
13	Podlaskie	68.8	**13**	Warminsko-mazurskie	69.2	**13**	Lubuskie	71.5
14	Warmińsko-mazurskie	68.4	**14**	Podlaskie	69.1	**14**	Podlaskie	69.1
15	Lubuskie	59.7	**15**	Lubuskie	59.9	**15**	Warminsko-mazurskie	68.2
16	Swietokrzyskie	49.9	**16**	Swietokrzyskie	48.9	**16**	Swietokrzyskie	44.5

Source: own calculations on the basis of CSO and Eurostat data.

The leadership of Mazowieckie was to an elevated degree caused by high percentage of enterprises using information and communication technologies, the highest number of patents granted (by the Patent Office of Poland) and the largest participation of workers in the high-technology sector. Among the factors influencing the leadership were also the highest share of population with higher education in the country, very high activity rate and the highest rate of lifelong learning. The disadvantages of this region were relatively weak production automation, low percentage of waste recovery and one of the highest demographic dependency ratios in the country.

Pomorskie's advantage is the country's highest share of revenues from sale of innovative products, a relatively high proportion of workers in the high-technology sector, good infrastructure, including highways and expressways, as well as very high income per capita. Its weaknesses are, however, a high percentage of long-term unemployed and the country's lowest number of non-profit organizations. The Wielkopolskie region is characterized by high rates of production automation devices and an equally high percentage of enterprises using information and communication technologies, as well as a distinguishing network of highways, and psychological well-being. The greatest weaknesses of Wielkopolskie are very high levels of economic inactivity caused by exhausting all known job search methods, resulting in a significant population being at risk of poverty.

The Malopolskie region, similarly to Pomorskie, has a high percentage of revenue from sales of innovative products, relatively good infrastructure of highways, as well as the highest number of higher-education students per 10,000 inhabitants in the country, and one of the highest relative numbers of doctoral students. Malopolskie also has the highest positive balance of migration in the country and the lowest rate of the economically inactive. It has, however, a high demographic dependency ratio and the country's lowest (on a par with Podkarpackie) proportion of population using water supply facilities.

Dolnoslaskie is positively distinguished by the highest rate of patents granted, one of the highest rates of information and communication technologies' utilization, a high rate of workers in high-technology sectors, the second largest network of highways and expressways and low rate of life stress. The region has, however, one of the lowest rates of waste recovery, high dependency ratio, and a high level of economic inactivity. The Slaskie region is characterized by a high rate of automation of production processes, and the country's highest indicators of patents granted and of highway network, as well as one of the highest enrolment rates. The weakness of the region is the high rate of economic inactivity caused by exhaustion of job search methods, high demographic dependency ratio, small number of non-profit organizations, low rate of air pollution reduction in relation to the pollution generated, and one of the country's lowest indicators of physical well-being.

The position of Opolskie was determined by such advantages as the second highest score in patents granted, the highest percentage in water supply usage in the country and the lowest demographic dependency ratio and economic

inactivity among all regions. The elements which negatively affect the position of the region include the second worst result in foreign tourists attraction, similarly the second worst life stress rate in the country, the lowest percentage of people with higher education, as well as the lowest fertility rate and, at the same time, the highest negative net migration. Podkarpackie occupies the eighth position in the ranking and top position among the eastern, least-developed regions. The region's potential consists in a positive indicator of social well-being, the highest national relative level of automation of production processes and high percentage of companies using information and communication technologies. The potential of the region is also evidenced by high population growth and one of the highest economic activity rates in the country. The weaknesses of the region, however, include backwardness in infrastructure manifested by the lack of highways, one of the lowest square footages of dwellings per inhabitant in the country, low civilizational level, the lowest percentage of inhabitants using water supply, as well as a relatively low proportion of population with higher education. The Lubelskie region is characterized by the second largest percentage of companies that use information and communication technologies as well as second highest rate of reduction of air pollution produced, one of the highest economic activity and lifelong learning rates, high social capital and finally low level of life stress. The weaknesses of the region are the country's lowest share of net revenues from sales of innovative products, one of the lowest average monthly disposable income per capita and a negative indicator of the civilizational level. The Lodzkie region is characterized by a high rate of production automation, high rate of patents granted, as well as a very high proportion of people employed in high-technology sectors. Its weaknesses are, however, low share of net revenues from sale of innovative products, the lowest percentage of recycled waste in the country, the lowest rate of population growth and life expectancy, as well as the highest demographic dependency ratio. Also, a weakness of Lodzkie is the highest pathology rate in the country, one of the lowest civilizational level rates, and a very low social capital level.

Zachodniopomorskie is the penultimate region which did not change its ranking position during the period. The region's advantages are a high percentage of companies using information and communication technologies, as well as a high rate of patents granted. There is also a strong base for foreign tourists and a large number of non-profit organizations in the region. The position of the region is depreciated by small involvement in waste recovery and air pollution reduction, as well as a high rate of economic inactivity caused by the exhaustion of all known job search methods. Relatively low is the social well-being indicator, which is one of the lowest in the country.

The Kujawsko-Pomorskie region shows a very high level of automation of production processes, the country's highest percentage of companies using information and communication technologies, a high proportion of people employed in the high-technology sector, as well as relatively good expressway and highway infrastructure. Positive are also social capital indicators (low life stress, satisfactory level of psychological and physical well-being indicators, as

well as a high indicator of civilizational level). Disadvantages of the region are a high rate of natural unemployment, very low rate of inhabitants with higher education and equally low density of non-profit organizations. The Lubuskie region shows a relatively high rate of automation of production processes, the highest rate of enterprises that use information and communication technologies in the country, high share of people employed in the high-technology sector, and one of the highest expressway and highway length ratios in the country. Also noteworthy are very high index of waste recovery and extremely high enrolment rate, and the lowest rate of life stress. The weaknesses of the region are the country's lowest movement of passengers at airports, the lowest number of higher-education students and postgraduate students per 10,000 inhabitants and thus a low percentage of people with higher education. Lubuskie also has the lowest rate of social well-being and equally low rate of physical well-being.

The Podlaskie region is described by the following advantages: a high percentage of companies using information and communication technologies, one of the highest rates of inhabitants with higher education, an equally high rate of lifelong learning and, finally, the best life expectancy. The weaknesses of the region are the lowest percentage of granted patents in the country; the second-lowest rate of reduction of air pollution produced, a very high risk of poverty and a high rate of dependency ratio. Warminsko-Mazurskie is positively distinguished by high automation of production processes, the lowest demographic dependency ratio in the country, one of the highest fertility rates and one of the lowest natural unemployment rates. The weaknesses of the region are its last but one place in the ranking of patents granted, very poor epressway and highway infrastructure, the lowest square footage of dwellings in the country, the lowest percentage of air pollution retained in reduction devices, as well as one of the lowest indicators of higher-education students per 10,000 inhabitants and inhabitants with higher education, the lowest civilizational and social well-being level, and the highest rate of life stress.

The situation of Swietokrzyskie, last in the ranking, is quite different. Its advantages include the highest national percentage of recycled waste, relatively high activity rate and average life expectancy, and low life stress. The factors determining an unfavourable assessment of the region include a small percentage of companies using information and communication technologies and even lower percentage of patents granted, as well as a small share of employment in high-technology sectors. Swietokrzyskie is also characterized by a relatively low enrolment rate, very low percentage of higher-education students and doctoral students, as well as a small birth rate and low psychological well-being.

Figure 3 shows the mean values of the development index for Poland and the mean values of the groups of its components in the years 2009–2011.

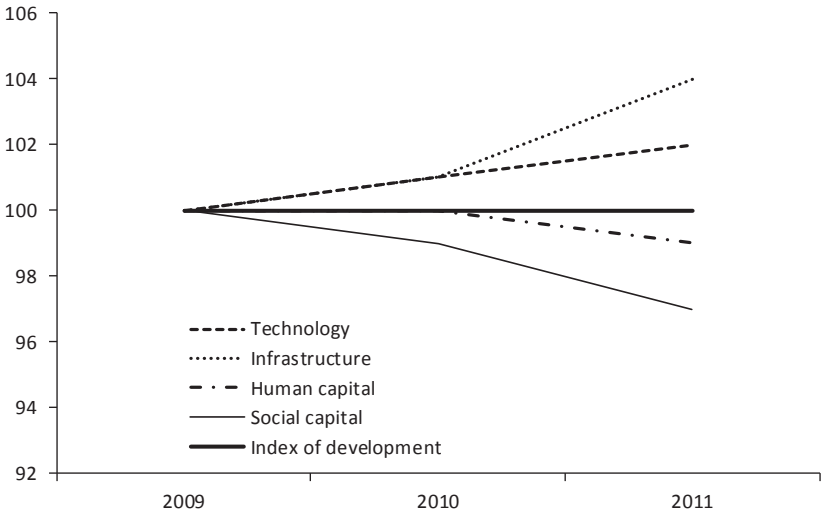


Figure 3. Average development index value for Poland and average values of groups of its components in 2009-2011

Source: own calculations on the basis of CSO and Eurostat data.

These results are not an indicator of growth in full gear values of GDP per capita. While in the case of Mazowieckie the highest human development index value corresponds to the highest value of GDP per capita, the lowest GDP per capita does not correspond to the indications given by development index (Table 4).

The criterion of GDP per capita indicates that the weakest region in 2009 and 2011 was Lubelskie, and in 2010 – Podkarpackie. The highest growth rate was found in Mazowieckie, and the lowest rate of GDP per capita changes did not concern Podkarpackie or Lubelskie, but the Podlaskie region. The greatest distance to the average GDP per capita applied to Lubelskie, Podkarpackie, Podlaskie, Warminsko-Mazurskie, and Swietokrzyskie.

The calculations allow to classify the examined regions in three groups, thus allowing to formulate recommendations as to the required improvements relating to each group of regions. The first of these are regions with the highest development index values (over 100 points). In this group of regions, next to Mazowieckie, were: Malopolskie, Slaskie, Podkarpackie, Wielkopolskie, Dolnoslaskie, Opolskie and Pomorskie. The average value of the index for the eight most developed regions in 2011 was 128.7 points, and the distance between the average for all the regions in Poland and the average for the regions with the highest indicator values amounted to 28.3 points. Considering the high values of technological and infrastructural ratios of these regions, to help achieve even higher index values improved should be actions aimed at stimulating the development of human capital and social capital. The calculated values show that the most significant weaknesses of highly-developed regions are high demographic load, high economic inactivity, low birth rate and high life stress indicator, as well as equally low social well-being.

Table 4. Position of the regions according to the criterion of GDP *per capita*

2009			2010			2011 (forecast)		
1	Mazowieckie	56 378,00	**1**	Mazowieckie	60 359,00	**1**	Mazowieckie	63 185,40
2	Dolnoslaskie	38 427,00	**2**	Dolnoslaskie	41 750,00	**2**	Dolnoslaskie	43 367,28
3	Slaskie	37 800,00	**3**	Slaskie	39 677,00	**3**	Slaskie	43 197,27
4	Wielkopolskie	37 462,00	**4**	Wielkopolskie	38 629,00	**4**	Wielkopolskie	41 619,15
5	Pomorskie	34 296,00	**5**	Pomorskie	35 597,00	**5**	Pomorskie	37 599,74
6	Lodzkie	32 204,00	**6**	Lodzkie	34 180,00	**6**	Lodzkie	36 458,02
7	Zachodniopomorskie	30 978,00	**7**	Zachodniopomorskie	32 268,00	**7**	Malopolskie	33 895,40
8	Malopolskie	30 251,00	**8**	Malopolskie	31 501,00	**8**	Lubuskie	33 676,13
9	Lubuskie	30 108,00	**9**	Lubuskie	31 348,00	**9**	Zachodniopomorskie	33 655,13
10	Kujawsko-pomorskie	29 866,00	**10**	Kujawsko-pomorskie	31 107,00	**10**	Opolskie	33 596,33
11	Opolskie	28 811,00	**11**	Opolskie	29 498,00	**11**	Kujawsko-pomorskie	33 074,72
12	Swietokrzyskie	27 357,00	**12**	Swietokrzyskie	28 134,00	**12**	Swietokrzyskie	31 058,21
13	Warminsko-mazurskie	26 029,00	**13**	Warminsko-mazurskie	27 228,00	**13**	Warminsko-mazurskie	28 669,36
14	Podlaskie	25 983,00	**14**	Podlaskie	26 985,00	**14**	Podlaskie	28 579,11
15	Podkarpackie	24 157,00	**15**	Lubelskie	25 079,00	**15**	Podkarpackie	26 904,38
16	Lubelskie	23 679,00	**16**	Podkarpackie	24 973,00	**16**	Lubelskie	26 780,77

Source: own work on the basis of CSO data.

The second group are the regions of development index values oscillating in the range of 80 to 100 points. In this group were: Zachodniopomorskie, Lodzkie and Lubelskie, and the distance separating them from the average calculated for the best regions amounted to 47.1 points, 46.4 points, and 44.7 points, respectively. This means that for those regions, the distance between them and the average for the regions with the highest index values was so significant that in each case it exceeded the value obtained by the weakest region in the country, that is Swietokrzyskie (44.5 pts).

In order to reduce the indicated distance, it is reasonable to focus on improving infrastructure indicators that require greater involvement, e.g. in waste recovery and air pollution reduction, as well as replacement investments in infrastructure and improvements in technology, requiring, among other things, focus (in the structure of industrial entities' influence) on increasing net revenues from sales of innovative products. Significant are also improvement possibilities relating to social capital resources (including initiatives for social well-being and the civilizational level indicator growth, as well as reducing the distance to highly-developed regions in terms of average monthly disposable income available).

The third group are the regions with index values in the range of 0 to 79 points. Although they represent the economically weakest area in Poland, the values describing them significantly differentiate them. The best region (Kujawsko-Pomorskie) of the economically weakest ones had an indicator value of 75.8 points, while Swietokrzyskie, the weakest region both in the group and in the country had an indicator value of 44.5 points. The average value of the indicator for the regions in this group was 65.8 points, thus it was significantly higher than the value of the development indicator for the weakest region in the country, namely Swietokrzyskie. Other regions: Warminsko-Mazurskie, Podlaskie and Lubuskie, had index values higher than the mean for the group (i.e. 65.8 points), that is, 68.2 points, 69.1 points and 71.5 points, respectively. In the case of regions belonging to the group with the lowest development index values, recommendations concern practically all categories of the development index components. In the area of technology, changes should concern an increase in patent development and submission, implementing modern production methods and technologies and, consequently, increasing the share of people employed in the sector of new technologies in the structure of all employed. In terms of infrastructure, changes should concern increased efforts to reduce air pollution, development of expressway and highway infrastructure, and improved availability of housing for residents in the region. In the area of human capital, changes should focus on reducing the scale of long-term unemployment threats, improving enrolment rates, reducing the current scale of the demographic burden, improving the balance of migration and increasing emphasis on improving indicators which show social interest in raising qualifications for higher education and doctoral studies level, and thus increasing the number of people with higher education in population structure. Finally, in the area of social capital, improvements should include better social, physical and psychological well-being, as well as higher civilizational level and a lower life stress index.

The presented analysis shows differences in the economic development of the country viewed by regions. Importantly, the results showed not only a cross-sectional variation within regions, but also within groups of regions, divided and classified by interval indicator values. Noteworthy are not only the distance between the best and the weakest region in the country, but also between the weakest and the strongest region within each of the separate groups. Thus the diversification of the regions' economic situation cannot be viewed from one angle only, i.e. by comparing economically dominant regions and economically distanced regions. The presented values suggest that it is equally important, if not more important, to analyze a region's growth determinants individually, with particular emphasis on establishing the causes of the distance within each of the groups of regions.

Conclusion

In the article, we proposed a multi-component index of economic development for NUTS-2 regions constructed for Poland. Multi-component development indices for NUTS-2 regions are not popular. Analysis at the level of regions has its own characteristics. Many measures are not available at the regional level. However, the economic situation does not vary as much as between countries, and therefore some measures can be omitted. Our index has advantages over the traditional measure – GDP per capita. It accounts for the factors determining long-run growth. However, we supplemented them with other development factors. As a result, the index shows the long-run economic path of a region, as well as external, structural and social effects of development. It is also not based on economic output. On the other hand, such an approach to a greater extent than currently popular indicators of the quality of life includes the role of long-run economic growth. We think this approach is needed nowadays when economies are approaching the limits of economic growth. We only took into account the long-run changes which are related to development, eliminating the effects of short-run fluctuations from the variables in the cases it was required.

The multi-componential approach allows us to analyze different dimensions of development, identify sources of advantages and disadvantages of regions and can provide recommendations for economic policy. An analysis made for Poland showed differences in classification of regions done with the use of GDP per capita and the index we proposed. Significant differences occurred with respect to the eastern regions of Poland: Podkarpackie, Lubelskie and Podlaskie. While these are among the least-developed regions of the European Union according to the GDP per capita measure, they were classified higher according to the index we proposed. Positive external effects were found in these regions, in opposition to relatively low per-capita output. This suggests that the economic diversity of regions cannot be considered one-dimensional, and that inclusion of social and environmental factors can change the developmental picture of a region.

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Appendix

Table 5. Final components of the index of regional development

Component of the Index	Source of data[a]
Technology	
• **Means of automation of production processes per number of economic entities** Devices (or combinations of machinery and equipment) which perform certain tasks without human participation, used to automatically control and regulate other equipment and to control technological processes to 1,000 companies.	CSO
• **The share of net revenues from the sale of market innovative products in the overall net revenues from sales** The share of net revenues from sales of new or significantly improved products (innovation) in industrial enterprises in net revenues from sales.	CSO
• **Percentage of employment in high-tech sectors**	Eurostat
• **Percentage of enterprises that use information and communication technologies** Percentage of enterprises using information and communication technologies in the total number of enterprises.	CSO
• **Patents granted by the Patent Office in Poland per 1,000,000 inhabitants**	CSO
Infrastructure **Physical capital**	
• **Highways and motorways per 100 km^2 of region area** Highways and motorways in kilometres per 100 km^2 area of the region.	CSO
• **Passenger traffic at airport** The sum of arrivals and departures of passengers.	CSO
• **Square footage of dwellings per inhabitant**	CSO
• **Percentage of inhabitants using water supply**	CSO
• **Gross value of fixed assets per economic entity**	CSO
Environment	
• **The share of recycled waste in the amount of waste generated**	CSO
• **The share of air pollutants retained in pollution reduction devices in the amount of pollution generated** Air pollutants retained in equipment to reduce pollutants in especially troublesome plants as % of pollutants produced. Gaseous pollutants without carbon dioxide.	CSO
• **National Parks and Nature Reserves** Number of national parks and nature reserves.	CSO
• **Foreign tourists using accommodation** The proportion of thenumber of foreign tourists using accommodation to a region's surface ratio.	CSO

Human capital
Education

• **Gross enrolment rates in lower secondary education** Gross enrollment ratio is the ratio of the number of students (as of the beginning of the school year) at a given level of education (regardless of age) to the population (as of December 31) in the age group defined as corresponding to this level of education.	CSO
• **Number of students per one computer with Internet access intended to be used by students**	CSO
• **College and university students per 10,000 inhabitants** The sum of students of public and private colleges and universities.	CSO
• **Doctoral students per 10,000 inhabitants**	CSO
• **The share of the population aged 25-64 with tertiary education**	Eurostat
• **People aged 25-64 participating in lifelong learning** Percent of adults aged 25-64 participating in education and training.	Eurostat

Demography

• **Dependency ratio** Number of people of retirement age and the number of people in the pre-working age ratio. Used with a negative sign.	CSO
• **Fertility rate**	CSO
• **Net migration per 1,000 inhabitants**	CSO
• **Birth rate per 1,000 inhabitants**	CSO

Labour market

• **Economic activity rate** Percentage of the economically active in the total population in the working age.	CSO
• **Share of economically inactive population due to exhaustion of all known job search methods and conviction of the impossibility of finding a job** Used with a negative sign.	CSO
• **The percentage of long-term unemployed** Used with a negative sign.	CSO
• **Natural rate of unemployment** Calculated as the Hodrick-Prescott trend of the unemployment rate and taken with the negative sign. Used with a negative sign.	Own calculations

Social capital
Health

• **The incidence of venereal diseases per 1,000 inhabitants** Used with a negative sign.	CSO
• **Incidence of tuberculosis per 1,000 inhabitants** Used with a negative sign.	CSO
• **Life expectancy at birth** Average value for women and men.	CSO
• **Infant deaths per 1000 live births** Used with a negative sign.	CSO

• **Physical well-being** Incidence of somatic symptoms, serious disease in the past year, degree of disability, intensity of health-related stress.	Social Diagnosis
• **Psychological well-being** Sense of happiness, assessment of life-as-a-whole, incidence of mental depression symptoms, assessment of the past year.	Social Diagnosis
• **Life stress** A sum of six categories of stress measured by experiences related to finance, work, liaison with public administration offices, bringing up children, marriage, environmental protection (home, surroundings).	Social Diagnosis

Social inequality

• **Life expectancy at birth: men and women ratio** A module from the following expression: ratio for men and women minus 1.	CSO
• **The unemployed: men and women ratio** A module from the following expression: ratio for men and women minus 1.	CSO
• **The economically active: men and women ratio** A module from the following expression: ratio for men and women minus 1.	CSO
• **Average monthly disposable income per capita**	CSO
• **Risk of poverty rate: percentage of people in households below the limits (a relative poverty line)** Used with a negative sign.	CSO
• **Civilizational level** educational level, ownership of modern communication devices and familiarity with them (satellite or cable TV, laptop, desktop computer, mobile phone, Internet connection, computer skills, Internet use), active command of foreign languages, driving license.	Social Diagnosis
• **Pathologies** Alcohol abuse and drug use, smoking, consulting a psychiatrist or psychologist, being a criminal or victim of crime (burglaries, assaults, thefts). Used with a negative sign.	Social Diagnosis
• **Social well-being** Lack of the feeling of loneliness, a sense of being loved and respected, number of friends.	Social Diagnosis

Community

• **Offences identified in completed proceedings per 10,000 inhabitants** Used with a negative sign.	CSO
• **Number of cinemas per inhabitant**	CSO
• **Number of museums per inhabitant**	CSO
• **Number of organized events** Number of events organized by local authorities.	CSO
• **Number of non-profit organizations**	CSO

• **Social capital** In a narrow sense. Activity for the benefit of the local community, participation in parliamentary elections in 2011 (in 2011 participation in elections in 2010, in 2009 participation in parliamentary elections in 2007, in 2007 participation in parliamentary elections and participation in the EU referendum in 2005), participation in non-obligatory meetings, positive attitude to democracy, membership in organizations and serving functions in them, the belief that most people can be trusted.	Social Diagnosis

[a] CSO – Central Statistical Office of Poland

Source: own work.

Table 6. Considered, but rejected preliminary indicators

Employees in R&D to total employment ratio
Patents filed with the Patent Office per 1,000,000 inhabitants
Gross value added per 1 employee
The annual rate of growth of potential production
Roads with hard surface per 100 km^2 of a region
Loading of goods at airports
Unloading goods at airports
Number of 5-star hotels to a region's surface ratio
Percentage of inhabitants using sewage
Percentage of inhabitants using gas installations
Budget revenues per 1 inhabitant of a region
Budget expenditure per 1 inhabitant of a region
Equipment and facilities for environmental protection and water management in rural areas
Foreign tourists using accommodation to a region's surface ratio
Expenditure on education as % of GDP
Gross enrolment rates in primary schools
Number of students per one computer with Internet access intended to be used by students (primary schools)
Postgraduate students per 10,000 inhabitants
Percentage of students of technical studies to total number of students ratio
Marriages per 1,000 inhabitants
Life expectancy (men 65 years)
Life expectancy (women 65 years)
Hospital beds per 10,000 inhabitants
Medical personnel
Social welfare benefits per 10,000 inhabitants
Risk of poverty rate: percentage of people in households below the limits (subsistence minimum)
Risk of poverty rate: percentage of people in households below the limits (statutory poverty)

Source: own work.

Table 7. Reliability analysis results for the year 2009

	Scale mean without component	Scale variance without component	Correlation with the overall index	R^2	Cronbach Alfa without component
Technology	0.0000	0.900	0.560	0.342	0.714
Infrastructure	-0.0006	10.041	0.659	0.435	0.631
Human capital	0.0000	10.247	0.535	0.300	0.707
Social capital	0.0006	10.293	0.506	0.275	0.722

Source: own work.